Academic Origins of Geneticists Cited in *Who's Who in America*

An Honors Thesis (HONRS 499)

by

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THESIS ABSTRACT

This study of 303 U.S. geneticists who are recognized in Who's Who in America focuses on their academic and geographic origins, professional fields, and memberships in professional organizations and honoraries. An attempt is made to identify characteristics for which geneticists are valued in society and for which they were chosen for recognition in Who's Who in America. In addition, comparisons are made between the male and female populations to address questions concerning the low percentage of females included in the study and further, to determine whether the females' accomplishments surpassed or merely equaled those of their male counterparts.

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INTRODUCTION

This study of selected members of the Genetics Society of America (GSA) and the American Society of Human Genetics (ASHG) was conducted to identify various characteristics of success of professional geneticists that lead to recognition in Who's Who in America (1). Geneticists were selected for this study on the basis of their inclusion in both the 1990-91 Membership Directory (2) of the GSA and ASHG and the 1990-91 edition of Who's Who In America.

Areas under investigation in this study included the academic preparation of the geneticists, their occupations and locations of employment, and their involvement in professional and academic organizations. Among the many questions explored were the following: 1) Are U.S. geneticists primarily recognized for their achievements in the academic, social, political, or business world? 2) Which, if any, particular academic and professional backgrounds make a U.S. geneticist more likely to be recognized for his or her accomplishments? and 3) Do female U.S. geneticists garner recognitions similar to those of their male counterparts for equivalent accomplishments, or must female geneticists achieve greater success in academics, employment and professional organizations before being granted recognition?

Although this study is distinctly different from two previous studies ["The Academic Origin of Geneticists in the United States" by Howard and Mertens, 1968 (3) and "Academic Origin of Geneticists

- A Second Look" by Mertens and Eastman, 1984 (4)], there are similarities among the three studies. The nature of the raw data summarizing geneticists' lives allows comparisons to be made between the related information and trends identified in the previous studies and the results found in the current study. In addition, the research methodology used for the current study is similar to that employed by Howard and Mertens, and Mertens and Eastman. For the 1968 (3) and 1984 (4) studies, geneticists' names were obtained respectively from the 1967 and the 1981 editions of the Directory of Members of the GSA. The current study used the 1990-91 combined Membership Directory (2) of the GSA and ASHG. Biographies were obtained for the 1968 study from the 11th edition of American Men of Science and for the 1984 study from the 14th edition, renamed American Men and Women of Science. In the current investigation, biographies were researched in the 1990-91 edition of Who's Who in America (1). This approach eliminated both the need for mailed questionnaires and the anticipated reduction of sample size due to the lack of response from some of the geneticists surveyed.

LITERATURE REVIEW

In recent decades there have been numerous changes in both the demographic trends of U.S. scientists and engineers and the rate at which these scientists and engineers have been produced. With less than 5 percent of 22-year old undergraduates majoring in science and engineering fields, and only 5 percent of these further pursuing Ph.D.'s in related areas (5), it is not difficult to explain the 6 percent decline over the past 20 years of science and engineering baccalaureates who earn doctorates in these fields (6). This has raised some concern about the future of science in the United States. In 1990 the National Science Foundation (NSF) (5) projected that engineering and the natural sciences will experience a decline of personnel of almost 400,000 by the end of the century.

For purposes of evaluating recent changes and projecting future supply and demand of scientists and engineers, several studies have been conducted to detail and summarize the backgrounds of individuals currently employed in the sciences and engineering. Prominent among these studies of academic preparation, employment history, and scientific achievement are those done by the NSF, which updates and publishes its own reports on a fairly regular basis. Also, of particular interest to the current investigation is the study conducted by Mertens and Eastman (4) which singles out geneticists for examination.

Several aspects of the research done by the NSF, Mertens and

Eastman, and other researchers lend themselves to comparison with data collected in the current study. Interesting differences among the general population of scientists and engineers, the general population of geneticists, and the population of "recognized" geneticists in the current study are anticipated. Because the geneticists in this study are recognized in Who's Who in America (1), one may expect to find significant differences from other scientists and engineers in the areas of academic preparation, membership in professional organizations, and acquisition of recognitions and awards. Further, one may expect that the women in the current study will differ from and possibly out-perform the men of the current study and the women investigated by the NSF and other researchers in previous studies.

Traditionally, science and engineering have been viewed as male professions. Although women's roles in science have been continually increasing, males still greatly outnumber females in science-related occupations. According to an NSF report (7), in 1988 women represented only 16 percent of all employed scientists and engineers in the United States. Incredibly, that was a 258 percent increase over comparable 1978 figures (7).

In a 1987 study of employed doctoral life scientists, the National Science Board (NSB) (8) found that only 22,109 of 107,378 life scientists were female. Results of a 1988 NSF study (9) were similar: women represented 21 percent of the 62,000 employed Ph.D. biologists. The same study (9) revealed that 30 percent of all employed biologists (with or without a Ph.D.) were women. Mertens

and Eastman (4) reported even fewer female geneticists, 14.1 percent of their sample.

Women's involvement in the sciences seems to be concentrated in three of eight major areas, whereas men's participation is more evenly distributed. According to the NSF publication Women and Minorities in Science and Engineering (7), of all women scientists employed in 1987, 33 percent were life scientists, 29 percent were psychologists, and 20 percent were social scientists. Corresponding statistics for the employed male scientists were 24 percent, 15 percent and 10 percent, respectively (7). While it seems that women may be advancing in at least these three areas, it should be noted that a single study does not portray the whole picture. It is true that women have made great advances in their participation in the sciences over the past few decades, but since the mid-1980's, that progress has slowed (5) due to higher attrition rates, unequal salaries, and underemployment of women.

The advancing age of the scientific community is another demographical concern for the future of American science. Mertens and Eastman (4) found that over 25 percent of the geneticists in their study were over 60 years of age, up from 13.7 percent in a 1968 study of geneticists (3). However, it was suggested that Mertens and Eastman's methodology may have imposed more rigid standards of achievement for inclusion in their study, thus selecting for an older population.

Other studies on the aging of scientists likewise reveal older populations, but not to the extent reported by Mertens and Eastman

(4). In a 1987 study of life scientists employed by four year colleges and universities, the NSB (8) found only 10.5 percent of its population above the age of 60 years. In another report in Science (10) it was revealed that in 1989 just above 10 percent of scientists were over 60 years old. In a comparison with 1979 figures, the Science (10) article reported little change in the older age groups, but major changes among the middle-age groups. In 1979 approximately 40 percent of the scientific population was 30 to 39 years of age, while only 30 percent was between the ages of 40 and 49 years (10). The 1989 results (10) showed a reversal, with approximately 26 percent of the scientists aged 30 to 39 years and almost 40 percent between the ages of 40 and 49 years.

In studies of academic preparation of U.S. geneticists, Mertens and Eastman (4) listed the institutions granting the most baccalaureate and doctoral degrees to geneticists, and they indicated the types of institutions granting the majority of these degrees. The study (4) also revealed that women averaged 7.6 years between completion of the baccalaureate and doctoral degrees, compared to males who averaged 6.3 years between the degrees.

Among other studies of academic preparation of U.S. scientists, David Blockstein (9) reported that since 1982 women have steadily earned 45 percent of baccalaureate degrees and 30 percent of doctoral degrees in science and engineering. Furthermore, in 1988 women earned up to 36 percent of the biological science doctorates (9).

Finally, Richard Atkinson (5) noted that approximately 21

percent of doctoral degrees in the biological sciences in 1987 were awarded by U.S. universities to non-U.S. citizens. This number is significant because foreign students were responsible, in part, for reversing the late 1970's downward trend in the number of Ph.D.'s awarded (5). In addition, approximately one half of foreign-born Ph.D. recipients enter the American labor force (5).

Employment statistics have changed gradually over the past decade. According to the 1991 article in Science (10), 57 percent of science and engineering Ph.D.'s were employed in educational institutions in 1979, and this percentage decreased to approximately 52 percent in 1989. At the same time the numbers employed in business and industry increased from approximately 26 percent in 1979 to approximately 32 percent in 1989 (10). The report (10) also indicated a slight decease in government employment to approximately 8 percent and a small increase in self employment, also to approximately 8 percent.

A 1988 NSF study (11) evaluated places of employment for 59,000 biological scientists. At that time, four year colleges and universities were the largest employer of these individuals, employing 65.4 percent (11). Industry followed, a distant second, employing 15.5 percent of biological scientists (11). The federal government was the third largest employer, followed by nonprofit organizations, hospitals and clinics, and state and local governments (11).

The same NSF report (11), revealed that the number of employed female science and engineering doctorates reached 58,000 in 1988,

an increase of 36,000 over 1975 figures. This represented an annual growth rate of 10 percent as opposed to the 4 percent annual growth rate for males (11). Although this growth rate for females is encouraging, the NSF (11) found that in 1985 women still comprised only 15 percent of all employed doctoral scientists and engineers.

While these studies into the backgrounds and experiences of scientists, engineers, and geneticists may be used to project the future supply and demand for scientific personnel, they may also be used as a tool for evaluation. By studying the productivity of scientists with known backgrounds, science students of the future may choose routes of scientific preparation that will allow them maximum productivity. Weaknesses of the scientists and scientific programs can be improved upon, and strengths may be enhanced. The current study of geneticists may well serve as such a learning tool so that present geneticists can examine their past endeavors and goals in order to develop even stronger geneticists and genetics programs and employment opportunities in the future. In addition, by increasing awareness about geneticists and the significant contributions they make to society, perhaps more public interest and investment into the advancement of the study of genetics will follow.

MATERIALS AND METHODOLOGY

Geneticists listed in the 1990-91 Membership Directory (2) of the GSA and the ASHG were researched for their inclusion in the 1990-91 edition of Who's Who in America (1). Of approximately 7,400 geneticists listed in the membership directory, 303 corresponding biographies were found among the 79,400 entries in Who's Who in America. The following information was recorded (Appendix I) for each of the 303 geneticists: 1) name, 2) occupation(s), 3) professional address, 4) year of birth, 5) age, 6) birthplace, 7) sex, 8) professional memberships, 9) degrees earned, 10) institutions where degrees were earned, 11) area of concentration for each degree, 12) years in which degrees were earned, 13) honorary degrees received, 14) brief work history, 15) research organism/ area of interest, 16) publication information, and 17) honorary organizations and accomplishments.

The data gathered in the preceding categories were then entered into a computer database for subsequent searches and sorts. Microsoft Works 2.0 was the software used in conjunction with a MacIntosh personal computer. Due to limited findings in Who's Who in America (1), for the area of concentration per degree, research organism, and publication information, these three categories were eliminated from the database. Several categories, however, were expanded so that the resulting database included the following fifty-nine field names: last and first names; professional

(institutional) address; department address; city, state, and zip code of employment; occupation(s); subject(s) taught if an educator; area of research if a researcher; year born; sex; city, state, and country of birth; membership status in ASHG, GSA, American Board of Medical Genetics (ABMG), American Genetics Association (AGA), Sigma Xi, American Association for the Advancement of Science (AAAS), American Society of Microbiology (ASM), American Society of Biological Chemists, Association of American Physicians, American Pediatrics Society, Phi Beta Kappa, National Academy of Science (NAS), American Academy of Arts and Sciences, and National Institutes of Health (NIH) study sections; degree, year of degree, and institution awarding degree for the undergraduate, masters, and doctoral levels, plus any additional degrees; honorary degrees; diplomate data; employment in teaching, research, medicine, or other areas; receipt of a Guggenheim, Fulbright, or Gairdner award, grant, or fellowship; receipt of a Nobel Prize, Lilly Research Award, National Medal of Science, NIH Research Career Development Award or NIH fellowship or grant; NIH employment; principal NIH study section of involvement; and a miscellaneous category for listing any genetics societies' presidencies held or other significant information.

The geneticists' occupations, subjects taught, and areas of research were numerically coded for entry into the database. Membership information was coded "y" (yes) and "n" (no). In those fields for which information was not available, "n" or 0 (zero) was recorded, depending on the alphabetical or numerical nature of the

entry. All other information was entered without coding.

The geneticists' years of birth were used to determine their ages as of December, 1991. The 13th edition of American Universities and Colleges (12) was used to determine the state, private independent, or private denominational status of the colleges and universities attended by the geneticists.

Searches and sorts were performed on the data in the database (Appendix II). Tables and graphs were generated from the results of the sorts for analysis and identification of significant qualities and properties that contribute to inclusion of geneticists in Who's Who in America (1).

DATA AND DISCUSSION

Baccalaureate Origins

The baccalaureate origins of the 303 U.S. geneticists were more diverse than either their master's or doctoral origins. Two hundred seventy-two bachelor's degrees were granted to 269 geneticists. Three geneticists received two baccalaureate degrees, while information concerning the undergraduate degree was not reported for the remaining 34 geneticists. The distribution of Bachelor of Arts and Bachelor of Science degrees was relatively equal with 149 B.A. and 123 B.S. degrees.

The 269 geneticists whose baccalaureate origins are known received this degree from 136 different institutions, 1.7 times as many as reported for their doctoral origins. Similarly, a 1983 study of 1186 members of the GSA (13) reported three times as many undergraduate institutions as doctoral institutions. Among the 136 baccalaureate institutions in the current study (Table 1), only 11 granted five or more baccalaureate degrees to the geneticists while 14 institutions awarded three or four such degrees. Finally, 26 institutions each granted two baccalaureate degrees, and 85 institutions each granted only one bachelor's degree to the geneticists.

Foreign and independent denominational schools constituted 37 of the 136 baccalaureate institutions (Table 2); however, the majority of baccalaureate institutions were either state supported

TABLE 1

INSTITUTIONS GRANTING BACCALAUREATE DEGREES TO GENETICISTS IN THE CURRENT STUDY

Name of Institution	Number of Degrees
Harvard University	18
Chicago, University of	10
Yale University	9
Columbia University	8
New York University	8
Brooklyn College	6
Cornell University	6
Iowa State University	6
California, University of	5
Illinois, University of	5
Pennsylvania, University of	5
Massachusetts Institute of Technology	4
McGill University	4
Minnesota, University of	4
New York, City College of	4
Oregon, University of	4
Rutgers University	4
Swarthmore University	4
Baylor University	3
Davidson College	3
Indiana University	3
Johns Hopkins University	3
Nebraska, University of	3
Purdue University	3
Wisconsin, University of	3
Alabama, University of	2
Bridgewater College	2
British Columbia, University of	2
Brown University	2
California Institute of Technology	2
Colgate University	2
Colorado, University of	2
Emory University	2
Hunter College	2
Kansas, University of	2
Maryland, University of	2
Michigan State University	2
Northwestern University	2
Oberlin College	2
Princeton University	2

TABLE 1 (cont)

INSTITUTIONS GRANTING BACCALAUREATE DEGREES TO GENETICISTS IN THE CURRENT STUDY

Name of Institution	Number of Degrees
Rochester, University of	2
Texas, University of	2
Toronto, University of	2
Tufts University	2
Union College	2
Virginia, University of	2
Washington, University of	2
Washington and Lee University	2
Wayne State University	2
Western Reserve University	2
Wooster, College of	2
Acadia University	1
Albright University	1
Amherst University	1
Annamaria University	1
Augustana University	1
Ball State University	1
Barnard College	1
Bern, University of	1
Bernard College	1
Bowling Green State University	1
Bryn Mawr College	1
California State Polytechnic College	1
California, University of at Los Angeles	1
Cambridge University	1
Carnegie Institute	1
Carroll College	1
Cedarville University	1
Central College	1
Cincinnati, University of	1
Colorado State University	1
Dartmouth College	1
Duke University	1
Franklin and Marshall College	1
Friends University	1
Georgia, University of	1
Gettysburg College	1
Goucher College	1
Guys Hospital University	1
Haverford College	1

TABLE 1 (cont)

INSTITUTIONS GRANTING BACCALAUREATE DEGREES TO GENETICISTS IN THE CURRENT STUDY

Name of Institution	Number of Degrees
Hong Kong, University of	1
Howard College	1
Illinois Institute of Technology	1
Illinois University, Eastern	1
Ireland, National University of	1
Jacksonville State University	1
Kentucky State College, Western	1
Kentucky University, Western	1
Kenyon College	1
Kerala, University of	1
King College	1
LaGrange College	1
London University	1
Lwow, Polytechnic Institute of	1
Madrid, University of	1
Mansfield University	1
Miami, University of (Ohio)	1
Michigan, University of	1
Michigan, University of (Eastern)	1
Missouri State University, Southwestern	1
Missouri, University of	1
Mount Holyoke College	1
Nebraska State College	1
New Mexico, University of (Eastern)	1
North Carolina State College	1
North Carolina, University of	1
Ohio State University	1
Oklahoma Baptist University	1
Oklahoma State University	1
Oklahoma State University, Southern	1
Ontario, Western University of	1
Oregon State Agricultural College	1
Oxford University	1
Pennsylvania State University	1
Phillips University	1
Pittsburgh, University of	1
Pomona College	1
Queens College	1
Reed College	1
Saint John's University (Shanghai)	1

TABLE 1 (cont)

INSTITUTIONS GRANTING BACCALAUREATE DEGREES TO GENETICISTS IN THE CURRENT STUDY

Name of Institution	Number of Degrees
Samford College	1
San Diego State University	1
Saskatchewan, University of	1
South, University of the	1
Spring Hill College	1
Syracuse University	1
Taiwan, National University of	1
Tokyo University	1
Ursinus College	1
Vanderbilt University	1
Vassar College	1
Washington University (St. Louis)	1
Wesleyan University	1
William and Mary College	1
Williams College	1
Wilmington College	1
Total	272

TABLE 2

TYPES OF UNIVERSITIES GRANTING BACCALAUREATE DEGREES TO GENETICISTS IN THE CURRENT STUDY

Type of Institution	Number of Institutions	Percent of Institutions
State supported	53	39.0
Independent nonprofit	46	33.8
Independent denominational	17	12.5
Foreign/ Not listed	20	14.7
Total	136	100.0

state supported (39 percent) or independent nonprofit institutions (33.8 percent). The data in Table 3 show that independent nonprofit colleges and universities awarded 45.2 percent of the baccalaureate degrees, followed by state supported institutions which awarded 37.1 percent of such degrees. These findings contrasted with results of Mertens and Eastman's (4) 1984 study which reported 45.6 percent of GSA members' baccalaureate degrees granted by state supported institutions and only 28.2 percent granted by independent nonprofit institutions.

Of the eleven top baccalaureate colleges and universities in the current study (Table 4), 63.6 percent were independent nonprofit institutions, compared to 33.3 percent of the 12 leading institutions in the 1984 study. Furthermore, the current study found only 36.4 percent of leading baccalaureate institutions to be state supported, while 50 percent of such institutions were reported in 1984. Due to differences in the classification of institutions between the two studies, the 1984 study also attributed 16.7 percent of its leading baccalaureate institutions to be locally controlled colleges. The current study had no category for locally controlled colleges.

Interesting to note were the differences between the leading baccalaureate institutions of GSA members in 1984 and the leading baccalaureate institutions of the current study's geneticists who were recognized in Who's Who in America (1) (Table 4). Leading institutions reported in the current study but not in 1984 include Columbia University and New York University, both among the current

TABLE 3

BACCALAUREATE DEGREES BY INSTITUTION TYPE GRANTED TO GENETICISTS IN THE CURRENT AND 1984 STUDIES

Institution Type	Current		1984	
	Number of Degrees	Percent of Population	Number of Degrees	Percent of Population
State supported	101	37.1	534	45.6
Independent nonprofit	123	45.2	330	28.2
Independent denominational	23	8.5	131	11.2
Foreign/ not listed	25	9.2	121	10.3
Local*	-	-	54	4.6
Total	272	100	1170	99.9+

* The classification system of institutions in the current study did not include the category of local colleges.

+ Total does not equal 100 percent due to rounding.

TABLE 4

LEADING BACCALAUREATE INSTITUTIONS: A COMPARISON BETWEEN GENETICISTS IN THE CURRENT STUDY AND THOSE IN THE 1984 STUDY

Current Study (272 Baccalaureates)	Number of Degrees	Percent of Degrees
Harvard University	18	6.6
Chicago, University of	10	3.7
Yale University	9	3.3
Columbia University	8	2.9
New York University	8	2.9
Brooklyn College (CUNY)	6	2.2
Cornell University	6	2.2
Iowa State University	6	2.2
California, University of	5	1.8
Illinois, University of	5	1.8
Pennsylvania, University of	5	1.8

1984 Study (1170 Baccalaureates)	Number of Degrees	Percent of Degrees
California, University of	53	4.5
Cornell University	41	3.5
Illinois, University of	30	2.6
Harvard University	27	2.3
Iowa State University	22	1.9
Brooklyn College (CUNY)	21	1.8
Wisconsin, University of	19	1.6
Minnesota, University of	17	1.5
Nebraska, University of	17	1.5
Chicago, University of	16	1.4
New York, City College of	16	1.4
Yale University	16	1.4

study's top five baccalaureate institutions, and the University of Pennsylvania. The University of Minnesota, University of Nebraska, and University of Wisconsin, in addition to the City College of New York, were included among the 1984 study's leading baccalaureate institutions; however, they did not appear among those of the current study. Of the colleges and universities reported in both studies, few remained in the same ranked order. Harvard University, which granted 2.31 percent of baccalaureate degrees and ranked fourth among the leading baccalaureate institutions in Mertens and Eastman's study (4), appeared in first place in the current study, granting 6.6 percent of the bachelor's degrees. The University of Chicago and Yale University, which tied for ninth place in the 1984 study, each with 1.4 percent of the baccalaureates, were reported in the current study in second and third place, respectively granting 3.7 and 3.3 percent of the baccalaureate degrees. Other institutions which ranked high among the 1984 study's leading universities, but low among those of the current study, were the University of California, the University of Illinois, Cornell University, and Iowa State University.

Almost 64 percent of the 86 baccalaureate degrees granted by leading colleges and universities were B.A. degrees compared to 54.8 percent of B.A.'s for the population of 303 geneticists being studied. Only 36 percent of the baccalaureates from the leading institutions were B.S. degrees compared to 45 percent for the entire population under study.

Master's Degree Origins

Data for the master's degrees of the 303 geneticists were the most limited of the degree data. Of the 41.6 percent of the geneticists who hold master's degrees, 123 individuals possessed one and three individuals earned two. No master's degree information was available for the remaining 177 geneticists, many of whom may not have completed this degree.

The distribution of master's degrees between the arts and sciences differed greatly from comparable baccalaureate degree distributions. While Bachelor of Arts degrees accounted for 54.8 percent of baccalaureate degrees, Master of Arts degrees represented only 40.3 percent of the master's degrees granted. Master of Science degrees, however, accounted for 57.4 percent of master's degrees, a great increase over the 45.2 percent of baccalaureate degrees in the sciences. Other master's degrees (M.B.A., M.Ph.) accounted for the remaining 2.3 percent of degrees awarded.

Of the 57 institutions (Table 5) which granted master's degrees to the geneticists, 36 granted only one such degree while six granted two degrees, and five granted three. These were followed by three colleges and universities which granted four master's degrees each and seven institutions which awarded five or more master's degrees. Like the baccalaureate institutions, the master's institutions were primarily (58 percent) state supported. Fifteen of the 57 master's institutions were independent nonprofit

TABLE 5

INSTITUTIONS GRANTING MASTER'S DEGREES TO GENETICISTS IN THE CURRENT STUDY

Name of Institution	Number of Degrees
Harvard University	14
Columbia University	12
California, University of	7
Illinois, University of	6
Michigan, University of	5
Texas, University of	5
Yale University	5
Chicago, University of	4
Nebraska, University of	4
Wisconsin, University of	4
Iowa State University	3
Kentucky, University of	3
Oxford University	3
Purdue University	3
Washington, University of	3
Colorado, University of	2
Georgia, University of	2
Minnesota, University of	2
North Carolina State University	2
North Carolina, University of	2
Wayne State University	2
Adelphi University	1
Alabama University of	1
Annamalia University	1
Cambridge University	1
Colorado State University	1
Emory University	1
Guys Hospital University	1
Groningen, University of	1
Hebrew University	1
Jagellonian University	1
Kansas, University of	1
Kerala, University of	1
Massachusetts Institute of Technology	1
Maine University	1
McGill University	1
Mills College	1
Missouri, University of	1
New Hampshire, University of	1
New York, State University of	1

TABLE 5 (cont)

INSTITUTIONS GRANTING MASTER'S DEGREES TO GENETICISTS IN THE CURRENT STUDY

Name of Institution	Number of Degrees
New York University	1
Northwestern University	1
Ohio State University	1
Oklahoma State University	1
Oklahoma, University of	1
Oregon State University	1
Oregon, University of	1
Pennsylvania, University of	1
Rutgers University	1
Swiss Federal Institute of Technology	1
Tennessee, University of	1
Toronto, University of	1
Virginia, University of	1
Virginia Polytechnic Institute	1
Virginia Technical University	1
Washington State College	1
Washington University (St. Louis)	1
Total	129

schools, and nine were foreign colleges and universities or were not classified in American Universities and Colleges (12). State supported institutions of higher education awarded the most master's degrees, and independent denominational institutions granted the least, in this case zero. Seventy-one master's degrees were awarded by state supported colleges and universities, 49 were awarded by independent nonprofit institutions, and nine were awarded by foreign colleges and universities or by unclassified institutions.

Few differences existed between the types of leading master's institutions and the types of institutions granting all of the master's degrees. Of the leading ten master's institutions listed in Table 5, six are state supported, and four are independent nonprofit institutions. Those ten leading colleges and universities accounted for 51.2 percent of master's degrees awarded to the geneticists.

Doctoral Origins

More doctoral degrees than any other type of degree were reported for the 303 geneticists. All but two individuals earned at least one doctorate, and 27 earned two, leading to a total of 328 doctoral degrees granted. The data reported in Table 6 show the distribution of types of doctoral degrees. Ph.D.'s and M.D.'s constituted approximately 97 percent of the doctoral degrees earned, with Ph.D.'s outnumbering M.D.'s almost two to one. The remaining three percent included D.D.S., D.Sc., and J.D. degrees

TABLE 6

DOCTORAL DEGREES GRANTED TO GENETICISTS IN THE CURRENT STUDY

Degree	Number of Degrees	Percent of Degrees
Ph.D.	208	63.4
M.D.	111	33.8
D.D.S.	4	1.2
D.Sc.	3	0.9
J.D.	1	0.3
D.Ch.	1	0.3
Total	328*	99.9+

* Total exceeds number of geneticists because 301 of 303 were granted at least one doctorate, and 27 of the 301 were granted a second doctorate.

+ Total does not equal 100 percent due to rounding.

among others.

Only 80 colleges and universities (Table 7) granted the 328 doctoral degrees, thereby making doctoral origins less diverse than those of either the bachelor's or master's degrees. Harvard University, Columbia University, and Yale University each awarded more than 20 doctorates. Furthermore, six additional institutions each awarded between ten and twenty doctorates to the geneticists. Combined, these nine institutions were responsible for 47.3 percent, or 155, of the doctoral degrees awarded. The remaining half of the doctorates were granted by 71 institutions, 33 of which granted between two and nine doctorates and 38 of which granted single doctoral degrees.

The 80 institutions granting the geneticists' doctoral degrees included 32 state supported, 25 foreign or unclassified, 21 independent nonprofit and only two independent denominational institutions. Foreign or unclassified institutions represented 31.3 percent of the doctorate-granting institutions, but only 24.3 percent of baccalaureate and 15.9 percent of master's institutions.

Although there were more state supported institutions than any other type among the 80 universities granting doctorates, the state supported colleges and universities placed second to independent nonprofit institutions for the number of degrees awarded (Table 8). These independent nonprofit colleges and universities granted 54.6 percent, or 179, of the 328 doctoral degrees, an average of 8.5 degrees from each nonprofit institution. One hundred eleven doctorates , 33.8 percent of the 328 degrees, were awarded by state

TABLE 7

INSTITUTIONS GRANTING DOCTORAL DEGREES TO GENETICISTS IN THE CURRENT STUDY

Name of Institution	Number of Degrees
Harvard University	32
Columbia University	28
Yale University	21
California, University of	20
California Institute of Technology	12
Chicago, University of	11
Wisconsin, University of	11
Johns Hopkins University	10
Pennsylvania, University of	10
Minnesota, University of	9
New York University	9
Texas, University of	8
Illinois, University of	7
Michigan, University of	7
Rochester, University of	7
Northwestern University	6
Washington University (St. Louis)	6
Indiana University	5
McGill University	5
Rockefeller University	5
Massachusetts Institute of Technology	4
Purdue University	4
Alabama, University of	3
Cambridge University	3
Cornell University	3
Duke University	3
Iowa State University	3
North Carolina State University	3
Oregon, University of	3
Stanford University	3
Toronto, University of	3
Virginia, University of	3
Washington, University of	3
Western Reserve University	3
Colorado, University of	2
Hokkaido, University of	2
Kentucky, University of	2
London, University of	2
New York, State University of	2
Ohio State University	2

TABLE 7 (cont)

INSTITUTIONS GRANTING DOCTORAL DEGREES TO GENETICISTS IN THE CURRENT STUDY

Name of Institution	Number of Degrees
Oxford University	2
Tokyo University	2
Albert Einstein College of Medicine	1
Bowman Gray School of Medicine	1
Buffalo, University of	1
Cairo University	1
Charles University	1
Chile, University of	1
Cincinnati, University of	1
Cracow, Medical Academy of	1
Edinburgh University	1
Emory University	1
Freiburg, University of	1
Gdansk, Polytechnical Institute of	1
George Washington University	1
Glasgow University	1
Guys Hospital University	1
Hawaii, University of	1
Houston, University of	1
Jefferson Medical College	1
Kansas, University of	1
Lerden, University of	1
Madrid, Central University of	1
Maryland, University of	1
Michigan State University	1
Milan, University of	1
Nebraska, University of	1
NiJmegen, University of	1
North Carolina, University of	1
Ontario, University of (Western)	1
Oregon State University	1
Pittsburgh, University of	1
Rutgers University	1
Tennessee, University of	1
Tufts University	1
Union Theologian Seminary	1
Vanderbilt University	1
Vienna, University of	1
Virginia, Medical College of	1
Washington State College	1

TABLE 7 (cont)

INSTITUTIONS GRANTING DOCTORAL DEGREES TO GENETICISTS IN THE CURRENT STUDY

Name of Institution	Number of Degrees
Not listed	1
Total	328

TABLE 8

DOCTORAL DEGREES, BY INSTITUTION TYPE, GRANTED TO GENETICISTS IN THE CURRENT AND 1984 STUDIES

Institution Type	Current		1984	
	Number of Degrees	Percent of Degrees	Number of Degrees	Percent of Degrees
State supported	111	33.8	676	56.6
Independent nonprofit	179	54.6	427	35.8
Independent denominational	2	0.6	12	1.0
Foreign/ not classified	35	10.7	79	6.6
Not listed	1	0.3	0	0
Total	328	100.0	1194	100.0

supported colleges and universities which only averaged 3.5 doctorates per institution. Although more foreign and unclassified colleges and universities were listed than independent nonprofit universities as doctorate-granting institutions, foreign and unclassified universities awarded only 10.7 percent of the doctorates, followed by the 0.6 percent of doctorates contributed by independent denominational institutions.

The data in Table 8 indicate that once again there are significant differences between the academic origins of the GSA members in Mertens and Eastman's 1984 study (4) and those of the geneticists recognized in Who's Who in America (1) in the current study. Of the doctorates granted in the 1984 study, 56.6 percent were from state supported institutions, and only 35.8 percent were granted by independent nonprofit institutions. Those results were almost completely reversed in the current study, with 33.8 percent of doctorates from state institutions and 54.6 percent from independent nonprofit institutions. In both studies, the percent of degrees from foreign or unlisted colleges and universities was much lower than that of state or independent nonprofit institutions, and degrees from independent denominational institutions constituted one percent or less of doctoral degrees awarded.

Even among the leading doctoral universities in the current study (Table 9), a propensity existed toward attending independent nonprofit institutions. When the leading university types from both Mertens and Eastman's (4) study and the current study were

TABLE 9

LEADING DOCTORAL INSTITUTIONS OF GENETICISTS IN THE CURRENT AND 1984 STUDIES

Current Study (328 Doctorates)	Number of Degrees	Percent of Degrees
Harvard University	32	9.8
Columbia University	28	8.5
Yale University	21	6.4
California, University of	20	6.1
California Institute of Technology	12	3.7
Chicago, University of	11	3.4
Wisconsin, University of	11	3.4
Johns Hopkins University	10	3.0
Pennsylvania, University of	10	3.0
New York University	9	2.7
Minnesota, University of	9	2.7

1984 Study (1194 Doctorates)	Number of Degrees	Percent of Degrees
California, University of	113	9.5
Wisconsin, University of	60	5.0
Columbia University	49	4.1
Cornell University	48	4.0
Yale University	48	4.0
Texas, University of	47	3.9
Indiana University	45	3.8
Harvard University	44	3.7
California Institute of Technology	42	3.5
Minnesota, University of	39	3.3

compared, approximately 73 percent of the current study's and 50 percent of the 1984 study's leading doctoral institutions were independent nonprofit. Furthermore, approximately 27 percent of the current study's and 50 percent of the 1984 study's leading doctoral institutions were state supported.

When the leading doctoral institutions of the current and 1984 studies were compared (Table 9), seven of the ten leading universities of 1984 appeared among the top eleven institutions of the current study; however, their ranked orders had been shuffled. The University of California, which had been the leading doctoral institution of the 1984 study with 9.5 percent of the doctoral degrees awarded, ranked fourth in the current study, granting only 6.1 percent of doctorates. Conversely, Harvard University had granted only 3.7 percent of doctorates to GSA members in the 1984 study, but in the current study it appeared in the leading position, granting 9.8 percent of doctorates to geneticists recognized in Who's Who in America (1).

Three universities among Mertens and Eastman's top ten were not among the leading doctoral institutions of the current study. Those universities were Cornell University, Indiana University, and the University of Texas. Replacing them in the current study were the University of Chicago, Johns Hopkins University, the University of Pennsylvania, and New York University. The 11 leading institutions of the current study were responsible for 52.7 percent of the total number of doctorates granted.

Due to the greater number of Ph.D.'s than M.D.'s awarded,

differences were anticipated and later found between institutions granting the two degrees. Fifty-seven institutions granted 208 Ph.D.'s, leading to an average productivity rate of 3.6 Ph.D.'s per university. In comparison, 50 institutions granted the 111 M.D.'s, corresponding to an average productivity rate of 2.2 degrees per institution. Productivity rates were not the only differences between Ph.D.-granting and M.D.-granting institutions; disparities were also noted among the leading institutions granting the two types of doctorates (Table 10) and among the types of leading institutions.

Five universities, all independent nonprofit, were found among the leading producers of both Ph.D. and M.D. recipients: Columbia University, Harvard University, Johns Hopkins University, University of Chicago, and Yale University. Only one additional independent nonprofit institution, California Institute of Technology, was listed among the leading Ph.D. institutions. This resulted in the leading Ph.D.-granting institutions consisting of 60 percent independent nonprofit and 40 percent state-supported institutions. In contrast, four additional M.D. institutions were independent nonprofit. They were New York University, Northwestern University, University of Rochester, and University of Pennsylvania. A three-way tie allowed 11 universities to be listed among the leading M.D.-granting institutions. Of the two not previously mentioned, one was state-supported, and one was foreign. Leading M.D. institution types were finally calculated to include 81.8 percent independent nonprofit, 9.1 percent state supported and

TABLE 10

LEADING Ph.D. AND M.D. INSTITUTIONS OF GENETICISTS IN THE CURRENT STUDY

Ph.D. Institutions (208 Ph.D.'s)	Number of Ph.D.'s	Percent of Ph.D.'s
Columbia University	19	9.1
California, University of	19	9.1
Harvard University	18	8.7
Yale University	15	7.2
California Institute of Technology	12	5.8
Wisconsin, University of	9	4.3
Minnesota, University of	8	3.8
Johns Hopkins University	7	3.4
Texas, University of	7	3.4
Chicago, University of	6	2.9

M.D. Institutions (111 M.D.'s)	Number of M.D.'s	Percent of M.D.'s
Harvard University	14	12.6
Columbia University	9	8.1
New York University	8	7.2
Pennsylvania, University of	6	5.4
Yale University	6	5.4
Chicago, University of	5	4.5
Rochester, University of	5	4.5
Northwestern University	4	3.6
Johns Hopkins University	3	2.7
McGill University	3	2.7
Oregon, University of	3	2.7

9.1 percent foreign institutions. Although the ranked order of the institutions varied between the Ph.D. and M.D. lists, two universities, Columbia and Harvard, were listed among the top three for both doctoral degree types.

The 303 geneticists in the current study received their doctoral degrees at various ages ranging from 22 years to 45 years of age. The most common age of receipt of a doctorate, however, was 25 years, 1.4 years lower than the group's mean. Table 11 provides more detailed information about the ages at which the 303 geneticists received their first doctorate in comparison to the ages at which Mertens and Eastman's (4) GSA members received their first doctorates. Of significance is the fact that 18.8 percent of the 303 geneticists compared to only 4.9 percent of the geneticists in the 1984 study had received doctorates by age 24. Furthermore, when the 20 to 24 year age group was combined with the 25 to 29 year age group, results showed that 81.2 percent of the currently studied geneticists as opposed to only 65.3 percent of those in the previous study (4) had received at least one doctoral degree by age 29. By the age of 50 years, all the geneticists in the current study for whom appropriate information was listed had received doctorates.

Listed in Table 12 are the ten most productive universities in terms of granting any type of degree to the geneticists being studied. Harvard University was the leading producer of baccalaureate, master's, and doctoral degrees, granting a total of 64 degrees to the geneticists. Second only to Harvard University

TABLE 11

AGES AT WHICH FIRST DOCTORATES WERE GRANTED TO GENETICISTS IN THE CURRENT AND 1984 STUDIES

Ages	Current		1984	
	Number of Degrees	Percent of Degrees	Number of Degrees	Percent of Degrees
20 - 24	57	18.8	59	4.9
25 - 29	189	62.4	721	60.4
30 - 34	42	13.9	321	26.9
35 - 39	6	2.0	64	5.4
40 - 44	0	0	16	1.3
45 - 49	1	0.3	4	0.3
50 - 54	0	0	3	0.3
Age not given/ no doctorate	8	2.6	6	0.5
Total	303	100.0	1194	100.0

TABLE 12

INSTITUTIONS GRANTING THE MOST DEGREES OF ANY TYPE TO GENETICISTS IN THE CURRENT STUDY

Name of Institution	Number of Degrees
Harvard University	64
Columbia University	48
Yale University	35
California, University of	32
Chicago, University of	25
New York University	17
Pennsylvania, University of	15
Wisconsin, University of	15
California Institute of Technology	12
Illinois, University of	11

among master's and doctoral institutions, and ranking fourth among leading baccalaureate institutions was Columbia University which awarded a total of 48 degrees to the geneticists. Also included among the leading institutions granting all three degree types were Yale University, University of California, and University of Chicago. Of the ten universities and colleges granting the most degrees to the geneticists, seven were independent nonprofit and three were state supported.

Time Span Between Completion of Baccalaureate and Doctoral Degrees

The length of time that elapsed between the geneticists' completion of the baccalaureate and doctoral degrees ranged from zero to 27 years. While the most common time period was four years, the average length of time spent between degrees was 5.6 years. A comparison between the current study and that of Walter (13) (Table 13) revealed that the recognized geneticists in the current study completed their doctoral degrees in comparatively shorter time frames than did the members of the GSA in the 1983 study. Forty-six percent of the geneticists in the current study completed the doctorate in four years or less while only 26.9 percent of members of the GSA in the 1983 study succeeded in doing so. After six years had elapsed, 78.1 percent of the currently studied geneticists and only 64.2 percent of geneticists of the 1983 study had completed both their baccalaureate and doctoral degrees.

TABLE 13

TIME SPAN BETWEEN COMPLETION OF THE BACCALAUREATE AND DOCTORAL DEGREES OF GENETICISTS IN THE CURRENT STUDY COMPARED WITH A 1983 STUDY (13) OF GENETICISTS

Years Between Degrees	Current		1984	
	Number of Geneticists	Percent of Geneticists	Number of Geneticists	Percent of Geneticists
0	1	0.4	1	0.1
1	0	0.0	0	0.0
2	9	3.4	7	0.6
3	39	14.6	82	7.1
4	75	28.0	220	19.1
5	58	21.6	247	21.5
6	27	10.1	182	15.8
7	17	6.3	118	10.3
8	15	5.6	92	8.0
9	6	2.2	52	4.5
10	6	2.2	46	4.0
11	4	1.5	24	2.1
12	1	0.4	16	1.4
13	4	1.5	14	1.2
14	0	0.0	7	0.6
15	2	0.7	13	1.1
16	1	0.4	9	0.8
17	1	0.4	6	0.5
18	0	0.0	3	0.3
19	0	0.0	1	0.1
20	0	0.0	3	0.3
21	0	0.0	1	0.1
22	0	0.0	1	0.1
23	0	0.0	0	0.0
24	0	0.0	0	0.0
25	1	0.4	1	0.1
26	0	0.0	0	0.0
27	1	0.4	2	0.2
28	0	0.0	1	0.1
Total	268*	100.1+	1149	100.0

*This is the number of individuals for whom both baccalaureate and doctoral years were available.

+Total exceeds 100 percent due to rounding.